CLAIMS:

1. An optical interrogation system comprising:

an optical source operable to generate optical pulses, to be coupled into one end of an optical waveguide, the waveguide being optically coupled at its other end to one or more reflective optical elements to be interrogated;

optical amplifying and gating means to be optically coupled to the waveguide and being operable to selectively transmit an optical pulse returned from a reflective optical element under interrogation,

and being further operable to optically amplify an optical signal transmitted therethrough; and

optical detection means optically coupled to the optical amplifying and gating means, and being operable to detect a returned optical pulse transmitted by the optical amplifying and gating means.

2. An interrogation system as claimed in claim 1, wherein the optical amplifying and gating means is an optical amplifying device capable of switched operation, such that, when switched on, the optical amplifying and gating means transmits and amplifies an optical signal, and when switched off the transmission and amplification of optical signals is prevented.

3. An interrogation system as claimed in claim 1, wherein the optical amplifying and gating means is bi-directionally operable, and comprises a device selected from the group consisting of a semiconductor optical amplifier and a gain clamped semiconductor optical amplifier.

4. An interrogation system as claimed in claim 1, wherein the interrogation system further comprises drive apparatus for the optical amplifying and gating means, the drive apparatus being operable to generate electrical drive pulses of variable frequency and, to cause the optical amplifying and gating means to switch on and off.

5. An interrogation system as claimed in claim 1, wherein the optical source comprises the optical amplifying and gating means, wherein when the optical amplifying and gating means is switched on it simultaneously generates an optical signal, in the form of amplified spontaneous emission, and gates the optical signal into an optical pulse.

6. An interrogation system as claimed in claim 1, wherein the optical source comprises a continuous wave optical source operable to generate a continuous wave optical signal, such as a super-luminescent optical diode, coupled to the optical amplifying and gating means, wherein as the optical amplifying and gating means is switched on and off it gates the continuous wave optical signal into optical pulses.

7. An interrogation system as claimed in claim 1, wherein the optical source comprises a pulsed optical source operable to generate optical pulses.

8. An interrogation system as claimed claim 1, wherein the optical detection means comprises a photodetector.

9. An interrogation system as claimed in claim 1, wherein the optical detection means comprises wavelength evaluation apparatus, such as a wavemeter, an optical spectrum analyser or an optical filter element having a wavelength dependent filter response followed by optical detection means, such as a photodetector; the time of flight of the optical signal identifying which grating it was returned from and the wavemeter, optical spectrum analyser or optical filter and optical detection means measuring the wavelength of the optical signal.

10. An interrogation system as claimed in claim 1, wherein the interrogation system further comprises a section of optical waveguide coupled between the optical amplifying and gating means and the optical waveguide containing reflective optical elements to be interrogated.

11. An interrogation system as claimed in claim 1, wherein the interrogation system further comprises optical signal routing means configured to route an optical pulse returned from a reflective optical element being interrogated back through the optical

amplifying and gating means, in the direction towards the reflective optical element under interrogation.

12. An interrogation system as claimed in claim 11, wherein the optical signal routing means comprises an optical reflector provided after the optical amplifying and gating means, the spectral profile in reflection of the optical reflector covering the same spectral range as that occupied by the one or more reflective optical elements to be interrogated, and the reflector being located sufficiently close to the optical amplifying and gating means to ensure that the time it takes an optical signal to propagate from the optical amplifying and gating means to the reflector and back to the optical amplifying and gating means is shorter than the duration of the electrical drive pulse switching the optical amplifying and gating means on.

13. An interrogation system as claimed in claim 12, wherein a series of optical reflectors are provided after the optical amplifying and gating means, each reflector being located at a different distance from the optical amplifying and gating means, the most distant reflector being located sufficiently close to the optical amplifying and gating means to ensure that the time it takes an optical signal to propagate from the optical amplifying and gating means to the most distant reflector and back to the optical amplifying and gating means is shorter than the duration of the electrical drive pulse switching the optical amplifying and gating means on.

14. An interrogation system as claimed in claim 13, wherein the spectral profile in reflection of each optical reflector covers a different spectral range.

15. An optical sensor system comprising:

an optical waveguide coupled at one end to one or more reflective optical elements;

the optical waveguide being coupled at its other end to

an optical interrogation system as claimed claim 1.

16. An optical sensor system as claimed in claim 15, wherein the optical sensor system preferably comprises an optical waveguide coupled to a spaced array of optical waveguide gratings.

17. A sensor system as claimed in claim 16, wherein the resonant wavelength of each grating within the array lies within the same wavelength window, all of the gratings thereby operating within a single optical channel.

18. A sensor system as claimed in claim 17, wherein the gratings within the array are arranged in groups, each group containing a substantially identical set of gratings, the resonant wavelength of each grating within a group lying within a different wavelength window, and thus operating within a different optical channel, such that the time of flight of a returned optical pulse identifies which group a grating being interrogated belongs to.

19. A sensor system as claimed in claim 15, wherein the or each reflective optical element comprises: a Fabry-Perot etalon device, which may be a bulk optic Fabry-Perot etalon; an optical fibre Fabry-Perot etalon; an optical waveguide grating based Fabry-Perot etalon; an end of an optical fibre, which may be a mirrored end; the end of an optical fibre patch-cord; a break within a section of optical fibre; a crystal based reflective optical element; or a mirror element.

20. A sensor system as claimed in claim 15, wherein the sensor system comprises a plurality of optical waveguides each coupled at one end to one or more reflective optical elements, each waveguide being coupled to a respective optical amplifying and gating means.